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DISEASES AND PARASITES OF
POULTRY IN CALIFORNIA

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DISEASES AND PARASITES OF POULTRY IN CALIFORNIA¹

J. R. BEACH² AND S. B. FREEBORN³

INTRODUCTION

There are a number of diseases and parasites which may attack poultry and cause severe loss. The modern practice of raising large numbers of fowls continuously on relatively small areas has increased the likelihood of their occurrence. It is obvious, therefore, that some knowledge of the means of recognizing, preventing, and controlling the more common diseases and parasites is of great importance to all poultry raisers.

GENERAL PREVENTIVE MEASURES

The most effective means of combating diseases and parasites of all species of animals is to prevent their occurrence. This principle is especially applicable to poultry because fowls are commonly kept in such large flocks that disease may spread very rapidly and cause considerable loss before it is recognized. Furthermore, the value of a single fowl is so small that it is impractical to administer individual treatment to many sick ones.

Quarantine.—Disease is very often introduced by new stock. This is more apt to occur with grown birds than with chicks. It is safest, therefore, for a beginner to buy hatching eggs or day-old chicks. Adult birds which are added to existing flocks should be kept separate for at least two weeks before they are put with the others. Even with this precaution the presence of some infectious diseases, such as tuberculosis, may be overlooked.

Feeding.—Feeding methods are responsible for the sickness and death of birds in many flocks. Frequently losses from this cause are so numerous as to resemble the effect of an infectious disease. It is quite apparent, therefore, that proper feeding of fowls is an important factor in keeping fowls healthy.

¹ This publication is a revision of Experiment Station Circular 251.

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Yards.—The soil of yards in which diseased fowls or those infested with intestinal parasites are kept soon becomes contaminated with disease germs or parasite eggs. By this means disease and parasites may be spread to other fowls placed in the same yards. It is not practicable to treat soil with disinfectants or other chemicals. Parasite eggs may remain alive for years, but most disease germs which



Fig. 1.—Chicken-pox; cockerel. Natural infection.

affect fowls will die in a few months if the yards are not used. The danger of infection from this source will be greatly reduced if fowls are kept but a few months at a time in the same yards. The "double-yard system" which provides two yards for each house should be adopted. This will permit fowls to be kept in one yard while the

other is being plowed and cropped. It is also desirable that the soil be of a light sandy type and well drained, rather than of a heavy type or poorly drained. Water holes in the yards or moist areas around water troughs especially are to be avoided.

Houses.—The type of poultry house may have considerable bearing on the occurrence of disease. Sunlight is one of the most effective germ destroyers. Houses should be so constructed and located that the direct rays of the sun will reach all parts some time during each day. Other essential points are to provide good ventilation without

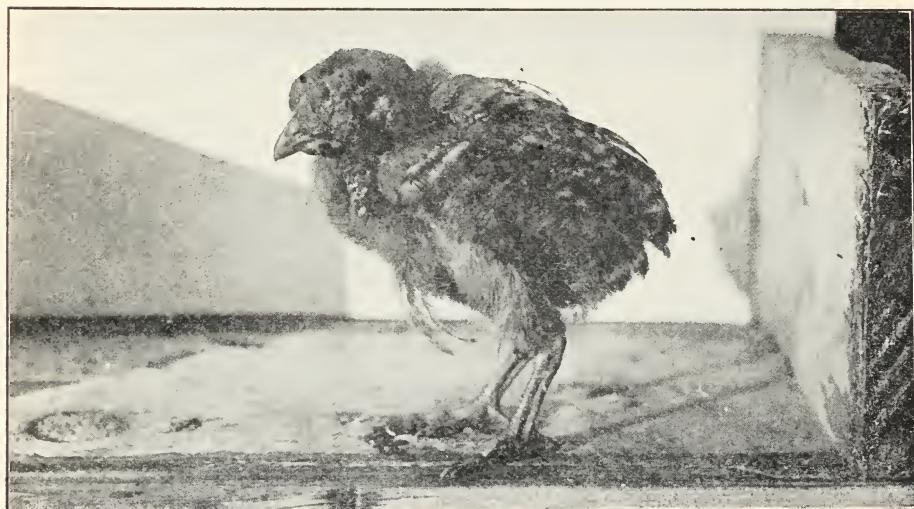


Fig. 2.—Chicken-pox; baby chick. Natural infection.

draftiness, to make provision for keeping out rain during stormy weather, and to provide drainage away from the house so that the floors will not become damp. The floors should be made of concrete or matched flooring, preferably the former. It is very difficult, if not impossible, to efficiently clean and disinfect a dirt floor. To facilitate cleaning, the house should be so arranged that all parts are easily accessible, and nest boxes, feed troughs, etc., should be removable.

Isolation of Sick Fowls.—The symptoms caused by some different diseases are so similar that it is not always possible, by symptoms alone, to differentiate between an infectious and a non-infectious one. Therefore, any sick fowls should be regarded with suspicion and be removed from the flock as soon as discovered. Strict adherence to this practice will assist in preventing serious outbreaks of infectious dis-

eases. A sick fowl either should be isolated in comfortable quarters and given proper care and treatment, or destroyed. It should not be simply taken out of the flock and allowed to roam around the farm at will. A fowl that is very sick or of questionable value as a producer should be destroyed rather than given treatment.



Fig. 3.—Canker; eye, from natural infection with chicken-pox virus.

Examination of Dead Fowls.—The presence of most infectious diseases and internal parasites can be best determined by autopsy of a dead fowl. It is a good practice to make an examination of all that die or are killed on account of sickness. By such examination the presence of disease or of parasites many times can be detected before they have made serious progress in the flock. All dead fowls should be disposed of by burning or deep burial in a place to which the fowls do not have access.

Cleaning.—Sanitation is essential for the maintenance of health in any flock. Under this heading is included cleanliness and the application of disinfectants and parasiticides. Cleanliness is perhaps the most important of the three. By thorough cleaning, many of the disease germs and parasite eggs will be removed. *Thorough cleaning* involves scrubbing with water after first sweeping and scraping. Cleaning is facilitated by the use of a hot lye solution (1 pound of lye in 40 gallons of water). Droppings of fowls are especially dangerous



Fig. 4.—Chicken-pox and canker of the eye, from natural infection with chicken-pox virus.

as a spreader of disease and, therefore, either the dropping boards should be cleaned daily or the roosts constructed so that the fowls do not have access to the droppings during the day. Litter should be removed and floors cleaned frequently. Drinking appliances should be emptied and cleaned daily. If moist mash is fed the troughs should be cleaned daily.

Disinfection.—Disinfectant should be applied *only after a thorough cleaning*. If applied to a dirty house, it will not penetrate the accumulations of filth and little benefit will be derived. Disinfectants are

most effective when applied in liberal amounts and sprayed with considerable force to all parts of the house from all directions so that the bottom of cracks will be reached. Most disinfectants cannot be relied upon to destroy parasites such as mites and ticks. For this purpose oily preparations are more effective. A disinfectant of known quality should be selected. One that is dependable and that can be obtained in any locality is Compound Solution of Cresol, containing 50 per cent cresylic acid. There are many such preparations marketed under various trade names. This disinfectant is used in a 3 to 5 per cent solution (1 pint in 3 to 5 gallons of water). The coal tar "sheep dips" are cheaper and are fairly effective. The "phenol coefficient" which is usually given on the container is an index of the efficiency of such products. The chlorine disinfectants are very efficient germicides but are too unstable to be suitable for poultry house disinfection. Preparations sold as crude carbolic acid are variable in their germicidal properties and, therefore, are not reliable disinfectants.

CHICKEN-POX AND CANKER OR AVIAN DIPHTHERIA

Description.—Chicken-pox is manifested by small wart-like growths on the comb, wattles, or skin of the head (figs. 1, 2, 5, and 6), and by the formation of masses of cheesy material or canker in the eyes and the mouth (figs. 3, 4, and 7). Although these last named lesions are entirely different in character from the lesions on the skin they are usually due to the same cause, namely, the virus of chicken-pox.⁴ This disease cannot occur unless the chicken-pox virus is present, although unsanitary conditions and poor methods of care and housing make it more likely to occur. Outbreaks are most prevalent during the fall and winter but may occur at any time of the year.

Outbreaks of chicken-pox vary greatly in severity. In some flocks but a few birds may be affected and practically no loss result, while in other flocks the lesions may be very severe; it may spread through almost the entire flock and cause a very great loss, both from decreased egg production and from the death of the infected fowls. The loss will be greater when a large percentage of the infected fowls have canker than when the lesions are largely on the skin.

⁴ Lesions in the mouth and eyes identical in appearance to canker may be caused by injury to the mucous membrane. Therefore, individual cases of canker may be due to a particle of litter, barley awn, weed seed, or similar material becoming lodged in the corner of the eye, the cleft in the roof of the mouth or in the larynx.

Control.—Outbreaks of chicken-pox and canker can be controlled by vaccination, in combination with sanitary measures. Vaccination is not advised unless the sanitary measures can be carefully carried out. The use of the chicken-pox vaccine has been very extensive in this state for several years past and the results obtained from vaccination have been quite satisfactory. Vaccine should be used on all birds in the flock as soon as the presence of chicken-pox in the flock is noticed.⁵ Vaccination of fowls before the appearance of the disease among them is not recommended. The reason for this is that the length of time after vaccination that fowls are protected against the disease is variable and after healthy flocks are vaccinated there is therefore no assurance that they will be protected longer than three or four months. If a flock is divided into a number of small pens and are under close observation, it may not be necessary to vaccinate the entire flock upon the appearance of the disease but only the fowls in the pens that are affected. In such cases the vaccine would be used in other pens as soon as the disease appears there.

If the vaccine is properly administered it does not have any harmful effect on the general condition of the birds. The egg yield, however, may be decreased for a short time after vaccination, but as a rule this decrease will be no greater than would be expected if the fowls were handled for any other reason.

Directions for Vaccination.—The materials required for vaccination are: the vaccine; a syringe; a small wide-mouth, covered vessel, such as a quarter-pint milk bottle provided with a stopper, or a jelly glass with a tight fitting cover, which is used as a vaccine container from which to fill the syringe; a pan of disinfectant; and a piece of absorbent cotton for cleansing the skin at the point of injection. The bottle of vaccine should always be thoroughly shaken before any vaccine is poured out and the wide-mouth container should always be thoroughly shaken before filling the syringe.

Chicken-pox vaccine is administered by injecting it beneath the skin with a hypodermic syringe (fig. 8). The dose is one cubic centimeter for each fowl. One dose is usually sufficient to check the spread

⁵ Chicken-pox vaccine can be obtained from the Division of Veterinary Science, University of California, at the actual cost of production, provided the applicant furnishes satisfactory evidence that chicken-pox exists among his fowls. The present cost of vaccine is 1½ cents per dose. Hypodermic syringes with which to administer the vaccine can also be procured from the University at a cost of \$4.00 each. All applicants should specify in writing the amount of vaccine desired or the number of fowls to be treated. Vaccine will be shipped only when cash accompanies the order, or C. O. D. When possible, orders will be shipped the same day they are received.



Figs. 5 and 6.—Chicken-pox; turkey. Natural infection.

of the disease in slightly infected flocks. A second treatment given five to seven days later is recommended for *all* birds in badly infected flocks. A flock may be re-vaccinated whenever the disease continues to spread a month after vaccination. The most convenient place for administering is beneath the skin of the breast under the right thigh. The bird may be held by the person administering the vaccine or by an assistant. If the person administering the vaccine holds the bird, the fowl



Fig. 7.—Canker of the mouth, turkey; from natural infection with chicken-pox virus.

should be laid on the left side with the left wing held back and the right wing, legs and feathers held back with the last three fingers of the left hand. The exposed skin should then be cleansed with a piece of cotton saturated with a good disinfectant, such as a 2 per cent solution of Compound Solution of Cresol (1½ tablespoonsful to a quart of boiled water), and picked up with the thumb and forefinger of the left hand. Then with the right hand, the syringe needle should be inserted *just beneath the skin* and 1 cubic centimeter of vaccine

injected. If an assistant holds the bird, both the wings should be held with the left hand, both legs with the right hand, and the bird placed on a table on its left side with the legs toward the operator. The skin should then be cleansed as directed above and picked up with the thumb and forefinger of the left hand and the hypodermic needle inserted *just beneath the skin*, being directed toward the head of the bird. Fowls can be vaccinated at the rate of 100 to 400 per hour according to the skill of the operator and the facilities for catching the birds. A syringe of 6 to 10 cubic centimeters capacity is well suited for this work. The needle should be 16 to 18 gauge and from 2 to 2½ inches over-all in length.

Sanitary precautions.—

1. Although the vaccine is preserved, the amount of preservative is not sufficient to keep it from spoiling if it is exposed to warm temperature for a considerable length of time. Furthermore, vaccine loses its efficiency with age and, therefore, it should be used within three days and never later than seven days after it has been prepared. If old or decomposed vaccine is used, unsatisfactory or bad results will follow.

2. The vaccine should be kept in a cool place on ice if possible, until used, and only one bottle opened at a time.

3. A small, wide-mouthed, covered vessel, such as a ¼-pint cream bottle or a jelly glass, should be provided as a vaccine container from which to fill the syringe. This should be sterilized by boiling before it is used and afterwards should be kept covered at all times except when the syringe is being filled. It should be well shaken each time the syringe is filled.

4. The syringe should be sterilized by boiling, or by soaking for at least five minutes in a 2-3 per cent solution of a good disinfectant and rinsing with boiling water.

5. The immunizing effect of the vaccine does not take place immediately; therefore, fowls already infected at the time of vaccination or that become infected soon after will develop chicken-pox lesions. Carefully examine each fowl at the time of vaccination and remove from the flock all that are diseased. Most of them will recover if given proper treatment.

6. A week later examine each fowl again and remove from the flock all that have become diseased since vaccination.

7. Do not return a diseased fowl to the healthy flock until the lesions are entirely healed.



Fig. 8.—Method of holding a fowl and injecting chicken-pox vaccine.

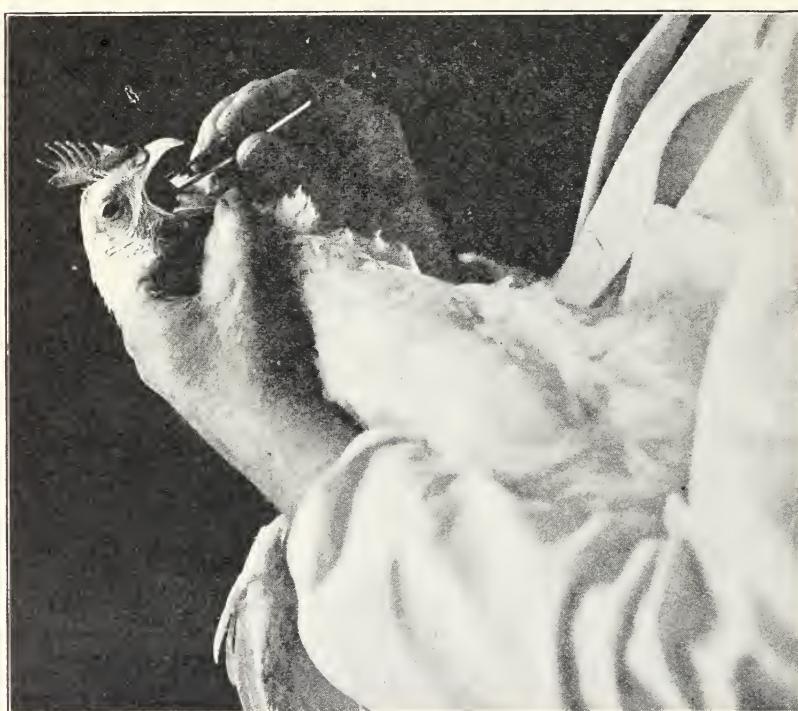


Fig. 9.—Method of holding a fowl and removing canker from the mouth.

8. Satisfactory results from vaccination cannot be expected if the diseased fowls are not separated from the healthy.

9. **The hypodermic needle should be inserted between the skin and the breast muscle, but not into the breast muscle.**

Treatment of Sick Fowls.—All diseased birds should be removed from the flock and kept in comfortable quarters where they can be given treatment at two- or four-day intervals. The scabs which form on the growths on the comb, wattles, or skin should be removed with



Fig. 10.—Method of holding a fowl and removing canker from the eyes.

a dull knife or a pair of forceps, and tincture of iodine applied to the exposed surface. Collections of cheesy material in the mouth should be removed with forceps (fig. 9) and tincture of iodine applied. Collections of cheesy material within the eyelids should be removed by pressing around the eye with the thumb and finger tips (fig. 10) and tincture of iodine applied. If the cheesy material adheres to the eyeball, it will be necessary to use forceps to remove it. In such cases the eyeball is usually destroyed before the recovery is complete. Tincture of iodine can be applied most conveniently and effectively with a medicine dropper. It will not in any way injure the eyesight or be

otherwise injurious to the birds. The administration of vaccine in addition to local treatment with iodine will hasten recovery and decrease the loss from death.

INFECTIOUS BRONCHITIS

Description.—This disease has been variously designated as infectious bronchitis, infectious tracheitis, tracheo-laryngitis, chicken "flu," and Canadian "flu." The length of time poultry of this country have suffered from it is not definitely known. Operators and employees of feeding stations claim that it has been present for many years, but losses caused by it have not been serious before the fall of 1924. In some poultry periodicals, the statement is made that it was introduced into this country by show birds from Canada in 1921. The first authentic report of its occurrence in the United States, however, appears to be that of May and Tittsler⁶ regarding an outbreak of tracheo-laryngitis in a Rhode Island flock in November, 1923. The first known occurrence of the disease in California was in November, 1924, in a flock of pullets. Since then numerous other outbreaks have occurred in poultry flocks throughout the state. Quite heavy losses were also sustained among fowls in fattening stations. These were chiefly among live fowls shipped from the Middle West (Nebraska), but also to some extent in fowls obtained from California flocks.

Losses have been heavier among young birds than among old ones, although fowls of all ages have been affected. It has been noted, however, that the mortality is less and continues over a shorter period in flocks of hens than in flocks of pullets.

The predominant symptom of the disease is "gasping for breath." The affected fowl assumes a sitting position, with the neck drawn in, the beak pointed downward and the eyes closed (fig. 11). At each inhalation, the head is thrown forward and upward, with the beak opened and the intake of air is accompanied by a loud wheezing sound (fig. 12). Spasmodic exhalation or coughing is frequent and often results in the expulsion from the trachea of a mass of clotted blood. Examination may reveal the larynx to be nearly filled with a caseous mass, while in other cases, in the live bird, the cause of the respiratory difficulty is not visible. Collections of mucous or caseous exudate are frequently found within the eyelids. This causes the eyelids to become glued together and, in case both eyes are affected, makes it

⁶ May, H. G., and R. P. Tittsler. Tracheo-laryngitis in poultry. *Jour. Amer. Vet. Med. Assn.*, n.s., 20: 229-231. 1925.

impossible for the fowl to see. There is usually a discharge from the nostrils. In many cases, this results in the nasal sinuses becoming filled and distended. This condition is indistinguishable from the commonly-occurring roup.

The onset of the disease is sudden and the spread through a flock very rapid. An outbreak usually causes a mortality of from 5 to 25 per cent of a flock during a period of from two to four weeks. The disease then disappears about as suddenly as it began. When there is more than one flock on a farm, it may attack one flock after another, but recurrences of the disease in the same flock are uncommon.



Fig. 11.—An advanced case of infectious bronchitis. Attitude during expiration.

The majority of the fowls that die do so within one or two days after symptoms appear. A large percentage of affected fowls that survive the first two days of sickness recover.

The cause of the disease is still undetermined. It has been quite definitely proved, however, that the disease is infectious and, therefore, that it is probably due to some species of bacteria or virus.

On autopsy, all organs are apparently normal with the exception of the larynx, the trachea, and the bronchi. The linings of these organs are usually found inflamed and their lumens wholly or partially filled with mucus and clotted blood. In some cases, probably those of several days' duration, the mucus in the larynx has become caseated. Occasionally caseous mucus is found extending the entire length of the trachea. In some birds, the amount of clotted blood

present exceeds that of mucus. The collection of mucus is sometimes confined to the lower portion of the trachea, the upper portion of the trachea and the larynx being entirely free.

The degree of inflammation of the mucous membrane varies from slight to an extent such as to impart a bright scarlet color to the membrane. The lungs appear normal except for small areas of congestion. Death in many cases appears to be due entirely to asphyxiation, caused by the filling of the larynx or trachea with caseated mucus or clotted blood.



Fig. 12.—Same fowl as fig. 11. Attitude during inspiration.

Control and Treatment.—The efforts to control outbreaks of infectious bronchitis should be directed toward limiting the spread as much as possible until the outbreak has run its course. It is probable that the rapid spread of the disease is in a large measure due to infection of healthy birds with the mucus and clotted blood expelled from the trachea of affected birds when they cough. A very important control measure, therefore, is the removal of affected birds from the flock before they have begun to cough. The flock should be continuously watched and all birds that exhibit the slightest respiratory difficulty immediately taken out. Other measures are the usual sani-

tary precautions, such as cleaning and disinfection of the houses. A disinfectant, such as potassium permanganate or a chlorine solution, may be added to the drinking water. Spraying the fowls at night with various preparations has been advocated. The apparent benefit obtained from such treatment is probably due to the fact that outbreaks naturally terminate quickly and that a large percentage of affected fowls recover even when no treatment is given.

A number of methods for the medicinal treatment of diseased birds have been used. These include chlorine solutions or argyrol, applied in the larynx and trachea; two drops of beechwood creosote in cod-liver oil, given daily; 3-grain doses of quinin sulphate, given three times daily; 20 minims of aromatic spirits of ammonia, every two hours; 5 c.c. doses of flavisol, subcutaneously; 20 to 30 grams of cal-eidin, in hot mash, daily; and avian mixed bacterins. Definite information seems to be lacking, however, regarding the actual value of any of these. Removal with forceps or tweezers of masses of caseous mucus or clotted blood that are within reach in the larynx or the upper portion of the trachea is a form of treatment that may save the lives of many birds.

COLDS AND ROUP

Description.—“Colds” are manifested by a discharge from one or both nostrils. When this discharge collects in the nasal sinuses it causes a marked swelling of the face and is rapidly transformed into a cheesy mass just beneath the eyes. This stage of the disease is called “roup.” If fowls did not get “colds,” they would not have roup. In turkeys, the material that collects in the nasal sinuses remains a thick, mucilaginous liquid. As a rule, “colds” and roup are confined entirely to the nasal passages, although in many cases the eyelids may become closed by the large swellings beneath them. Seldom, however, are the eyes affected in any other way. This disease is usually the result of housing or weather conditions, or poor condition of the birds rather than to any specific infection. Therefore, the usual cause of a large number in a flock becoming affected at one time is that all of the birds have been exposed to the same unfavorable condition, not because of contact of healthy with diseased birds. It is not likely to seriously affect any flock that is properly housed and cared for. Improper housing conditions are probably the most common cause of colds. Common faults in housing conditions are: presence of cracks in the walls back of the roosts; poor ventilation; over-crowding (particularly common in the case of young stock); damp-

ness, and insanitation. Extended periods of damp, cold weather, or periods during which there is a wide variation in temperature during the day and night, are apt to cause colds to become prevalent. Colds are particularly prevalent in pullets after they have been moved from brooding or rearing houses to laying houses. This is probably the result of the sudden change of environment. It is common for young birds that are infested with intestinal worms to be seriously affected with colds.



Fig. 13.—Fowl with roup.

Control.—The most important control measure is to determine and, if possible, remove the cause. The houses should be carefully studied for defects and any that are found corrected. Make certain that the number of birds is not too large for the house both during the day and night. When young birds are affected examine some of them for intestinal worms and give the birds proper treatment if any worms are found. Be sure the birds are fed a suitable ration. Keep the houses clean and dry.

Treatment.—A satisfactory treatment for individual colds consists in cleaning out the nostrils by pressing with the fingers and cleaning out the cleft with absorbent cotton on forceps or a match, and applying a drop of tincture of iodine in each nostril and in the cleft. This treatment should be repeated every three or four days. The treatment for roup is more difficult. It is probably more economical to destroy

birds having roup than to attempt treatment except in the case of birds of unusual value as layers or breeders. Treatment consists in opening the swelling with a sharp knife, removing the mass of cheesy material and packing the cavity with absorbent cotton saturated with tincture of iodine. The packing should be removed, the cavity cleaned and a new pack put in every five to seven days. If, upon removing the pack, no more cheesy material is found to have formed, the pack may be left out and the wound allowed to heal. Turkeys with roup do not respond to this treatment. A treatment⁷ for turkeys recently recommended consists in reducing the size of the swelling by pressing some of the discharge out through the nostrils and then injecting 1 c.c. (15 drops) of a 15 per cent solution of argyrol with a fine hypodermic needle. The injection is made below and in front of the eye. Great care must be taken not to tear the lining of the nasal passages nor to allow the argyrol to escape into the tissues.

If a large percentage of the flock have colds the following treatment may be used. Give Epsom salts in the drinking water, using one pound for each 125 adults or 200 to 400 birds under five months of age. The birds should have access to no other drink while the solution of Epsom salts is consumed. Following this, potassium permanganate may be added to the drinking water in sufficient quantity to produce a deep purple color. This should be replaced by fresh solution when the color changes to brown. Some tonic, such as the following, may be added to the mash:

Pulverized gentian	1 lb.
Pulverized ginger	1/4 lb.
Pulverized saltpeter	1/4 lb.
Pulverized iron sulphate	1/2 lb.
Pulverized nux vomica	1/4 lb.

Add one ounce of this mixture to each five pounds of mash and feed until the flock has recovered.

If faulty housing is causing colds reliance should not be placed on the treatment just described.

NUTRITIONAL ROUP

Description.—A disease very similar to roup in manifestation, which may affect a large percentage of a flock at one time, may be due to nutritional factors. The symptoms of this disease are weakness (fig. 14); emaciation; a discharge from one or both nostrils which

⁷ Tyzzer, E. E. The injection of argyrol for the treatment of sinusitis in turkeys. Cornell Vet., 16: 221-224. 1926.

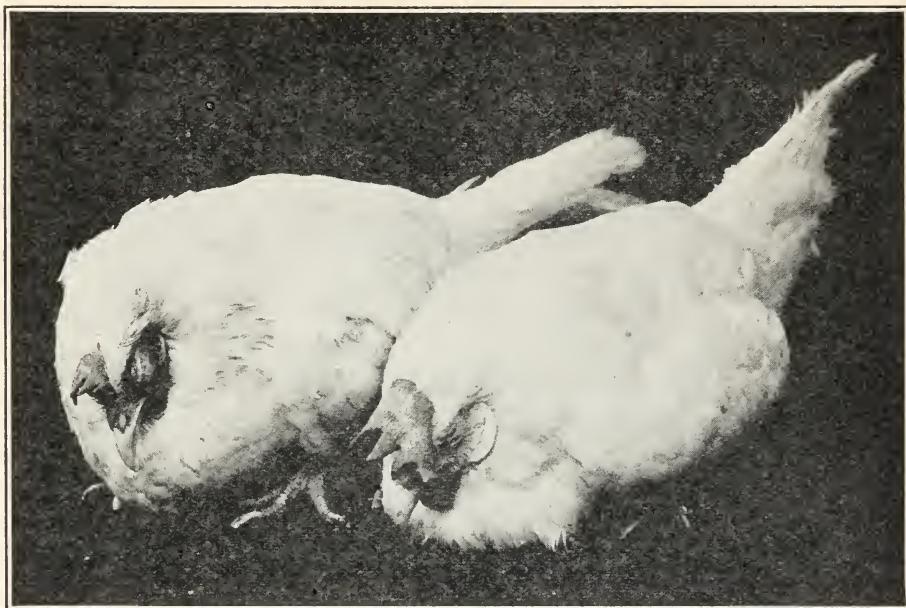


Fig. 14.—Typical appearance of fowls with nutritional roup.



Fig. 15.—Cheesy material in the eye of a fowl with nutritional roup.



Fig. 16.—An advanced case of nutritional roup, showing the pharynx and esophagus studded with pustules.

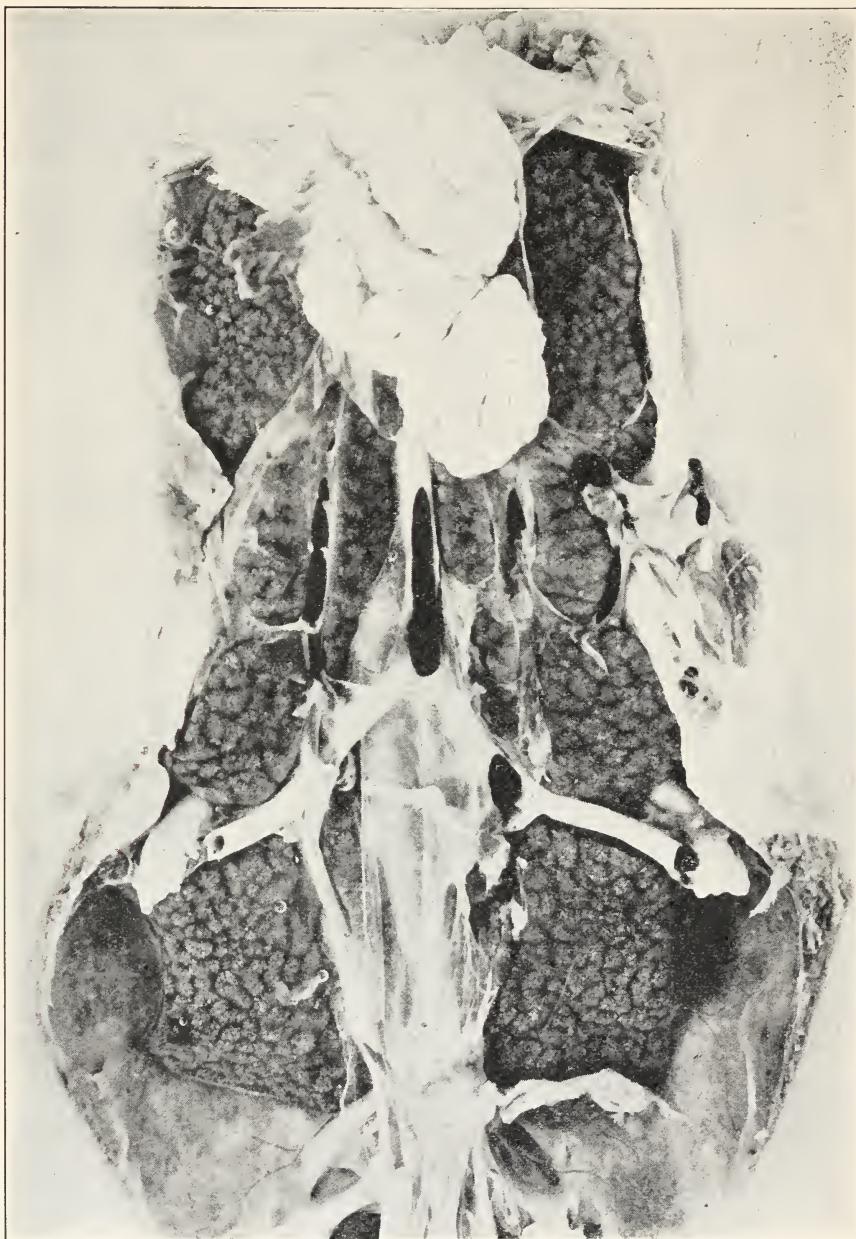


Fig. 17.—Kidneys of a fowl with nutritional roup.

may be followed by a swelling of the face beneath the eyes; a discharge from the eyes which may glue the eyelids together and be followed by the formation of an adherent white film over the third eyelid and a mass of white cheesy material within the eyelids (fig. 15); the formation of a yellowish white, round, cheesy pustule-like patches in the mouth and throat of about the size of a pinhead (fig. 16); and occasionally by the formation of masses of white cheesy material in the cleft or elsewhere in the mouth. This disease may be distinguished from chicken-pox by the absence of yellow color in the cheesy material and by the small size of the patches and color of the cheesy material in the mouth. It may be distinguished from "colds" and roup by the presence of lesions in the eye and mouth, in addition to nasal discharge and swelling of the face.

Postmortem examination of birds that have died usually shows the kidneys to be very pale and marked with a network of very fine white lines (fig. 17). Occasionally there is also found a deposit of a white material on the surface of the liver, on the membrane around the heart, or elsewhere on the surface of the organs.

It has been definitely determined that this disease is due to a deficiency of vitamin A in the ration. Since most of the vitamin A in poultry rations is supplied by green food, nutritional roup usually occurs when there is a shortage of this foodstuff. It may occur even though the birds are fed some green food if the amount is insufficient. It has also been found in flocks which had access to growing greens, but which were at a distance from the poultry house. In these cases some of the fowls were getting a sufficient supply of greens but most of them were not going far enough away from the house to get it.

Control.—This condition can be readily controlled by supplying the birds with more vitamin A. This is usually accomplished by increasing the amount of green food. Yellow carrots, alfalfa leaf and blossom meal, or cod-liver oil may be substituted for greens. The alfalfa leaf and blossom meal and the cod-liver oil are added to the mash in the proportion of 5 pounds and 1 quart respectively in 100 pounds of mash. Very sick birds should be given 1 to 2 c.c. (15-30 drops) cod-liver oil daily.

RUPTURED YOLKS

Description.—This disease usually occurs among flocks of pullets during the period of heavy production. Occasionally older birds are affected. It is manifested by a rather small but steady loss of birds. The infected fowls are usually sick but a very short time before death occurs and in a great many cases are found dead rather than sick.

The symptoms of the sick birds are droopiness, diarrhea, discoloration of the comb, usually followed by death within twenty-four hours. Birds may be found dead in the nests or on the dropping boards under the roosts. The fowls affected are those that are laying well.

The post-mortem examination of dead birds usually shows an enlarged, soft liver which may have minute yellowish white spots; sometimes small blood spots in the fat at the base of the heart or on the gizzard; sometimes inflammation of the intestines; and practically always egg yolk free in the abdominal cavity. The egg yolk may be like one freshly broken or may be in the form of a cheesy mass. In many of these fowls the presence of fowl cholera or fowl typhoid germs can be demonstrated. The germs found in such cases, however, are of such low virulence that death can rarely be caused by feeding or inoculating healthy birds with them.

Control.—This disease appears to be the result of heavy feeding and production, rather than entirely to infection with the fowl cholera or fowl typhoid germ. Good success in controlling this disease has been obtained by adding wheat bran to the mash to make it bulkier. This will automatically reduce the amount by weight of mash consumed and should also decrease egg production. If the losses have been very heavy the mash should be entirely replaced by bran until losses stop. If, however, not many birds are dying, the mash can be made one-half bran. It is also advisable to thoroughly clean and disinfect the houses and to use potassium permanganate in sufficient amount to give the drinking water a claret color, or to use some similar disinfectant in the drinking water. A one to two-thousand solution of bichloride of mercury is effective and safe. This must be used only in wood, glass, or earthenware vessels and must be kept away from other animals or from children.

FOWL CHOLERA

Description.—This disease is said to be responsible for severe losses among chickens in some states. In California, however, it appears to be a relatively unimportant cause of chicken mortality. The fowl cholera germ is often found in association with ruptured yolk (see p. 24) but the strains of the organism obtained from such cases are of such low virulence that it is very difficult to produce disease when healthy chickens are inoculated with them. Rather severe outbreaks of the disease in ducks and turkeys do occasionally

take place. In most instances such outbreaks could be attributed as much to the feeding and care the birds had received or to insanitary conditions of the premises as to the fowl cholera germ.

Even though the probability of severe losses from this disease may not appear to be great, it is always advisable to send specimens to a bacteriological laboratory for examination whenever sudden death of a few birds in good flesh occurs. This is the only means by which a definite diagnosis can be made.

Control.—Fowl cholera is not apt to occur if fowls are provided with sanitary yards, clean, properly constructed houses, and correct rations. If an outbreak should occur, the amount of food should be reduced and sanitary measures, such as cleaning and disinfection of the houses, feed hoppers, drinking vessels, and all other accessories, and the isolation of the sick should be carefully carried out. Reliance cannot be placed upon fowl cholera vaccines or bacterins in preventing or curing this disease.

FOWL TYPHOID

The occurrence of fowl typhoid in chickens and turkeys is not uncommon in some sections of California. It has been encountered more frequently in general farm flocks than in commercial flocks. The fowl typhoid germ is often found in association with ruptured yolk (see p. 24) but evidence to prove that it is a cause of this condition is lacking. Predisposing causes, such as exposure, improper diet, inadequate or insanitary quarters, appear to be necessary for an outbreak of this disease to occur and, therefore, the danger of its occurring in flocks that are properly housed, fed and cared for is not great. The control measures given for fowl cholera apply also to fowl typhoid.

The fowl typhoid germ is becoming of greater importance as a cause of disease of young chicks. The manifestations of this disease are identical with those of bacillary white diarrhea and can be distinguished from it only by bacteriological methods. Hens may acquire an infection of the ovaries with the germ and transmit it through eggs to offspring in the same manner as the bacillary white diarrhea germ. The method of prevention and control of fowl typhoid of chicks is the same as for bacillary white diarrhea. The agglutination test for the detection of hens that are carriers of the bacillary white diarrhea germ will also detect carriers of the fowl typhoid germ.

TUBERCULOSIS

Description.—This disease is caused by a specific germ and cannot be produced in any other way. Filthy, damp, crowded houses and yards serve to hasten the spread of the disease through a flock when the infection is present but such conditions are never responsible for the start of the disease. Infected birds exhibit symptoms of infection only in the advanced stages. Then they become emaciated, the comb and shanks are pale and shriveled, and some are lame. Losses from this disease do not often occur in birds less than one year old.

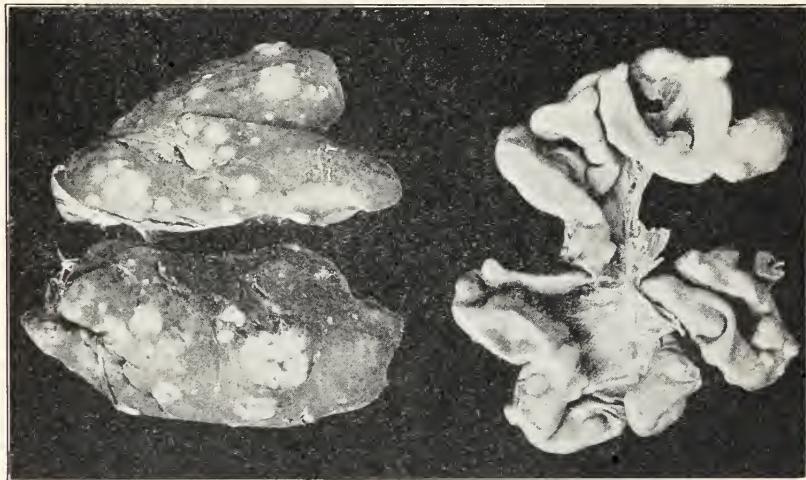


Fig. 18.—Tuberculosis nodules on the intestines and liver of a fowl.

The lesions of tuberculosis consist of round yellow spots varying in size from a pinhead to a pea in the liver and spleen, and nodules varying in size from a pea to a small walnut on the intestines or on the membrane which holds the intestines in place (fig. 18). Lesions also occur less frequently in the kidneys, lungs, skin and bones.

Tuberculosis spreads by fowls eating substances, such as food and soil contaminated by the discharges from the infected birds. The loss from tuberculosis is not apt to be great at any one time, but it will be constant and becomes increasingly severe as time goes on.

Control.—The observance of strict sanitary precautions and the practice of disposing of all fowls over two years old may assist in decreasing loss from the death of infected birds, but will accomplish little in lessening the extent of the infection in a flock. There are two possible methods of eradicating tuberculosis from a flock. The

first consists in disposing of all birds in the flock, thoroughly cleaning and disinfecting the house, leaving the yards vacant for a period of a few months and starting in again with new stock. If the yards are left vacant during hot or dry weather one or two months is sufficient. If, however, the ground is moist, from six months to a year may be required for the germs to die out. This is the most practical method to use in small flocks or flocks which are raised solely for egg production.



Fig. 19.—Fowl showing a positive reaction to the tuberculin test.

The other method of eradicating tuberculosis is by means of the tuberculin test. This test is made by injecting $\frac{1}{15}$ to $\frac{1}{20}$ cubic centimeter of substance known as tuberculin into the skin of the wattle. If an injected bird has tuberculosis the wattle will swell (fig. 19). It is necessary to make repeated tests at intervals of about six months to entirely free a flock from tuberculosis by this method. Following each test all reacting birds must be removed from the flock and the houses given a thorough cleaning and disinfecting. It is recommended to use this test only in flocks that are valuable as breeders.

COCCIDIOSIS

Description.—Coccidiosis is one of the most destructive diseases of young chickens. It is so widespread that, in poultry districts, practically all established poultry farms are infected and new farms quickly become so. The heaviest losses occur in chicks from four to eight weeks old. In infected flocks from 25 to 50 per cent and sometimes nearly all of the chicks die in two or three weeks. The large number of unthrifty or "cull" chicks among the survivors in infected flocks that have not been given effective treatment sometimes causes a greater loss to the poultryman than the mortality. Older birds become affected with a slowly fatal (chronic) type of the disease, which may be general in the flock or, as frequently happens, affect only a few birds. The disease frequently occurs in young turkeys as well as in chickens.

Coccidiosis is caused by the presence in the intestines of chicks of a microscopic, protozoan parasite called *Eimeria avium*.⁸ The parasite develops and multiplies in the cells of the walls of the intestines. The disease results from the injury to the cells during this period of development. In young chicks, the ceca (blind pouches) are the parts affected, while in older birds with the chronic type of the disease, the small intestines, rather than the ceca, are involved.

Severe outbreaks of coccidiosis so frequently occur in flocks which have not received suitable food or care or which are not properly housed, that some poultrymen believe it to be due to such conditions. These conditions do not cause coccidiosis, but render them more susceptible by lowering their natural resistance.

The disease is spread by chicks drinking water or eating food, litter or soil contaminated by the droppings of diseased chicks. It has been demonstrated that these parasites will remain alive in soil for a year or more. Therefore, chicks allowed to run in yards in which infected chicks were kept the preceding year are very liable to become infected. Thus far no practical method of chemical treatment of the soil to destroy these parasites has been developed.

⁸ Dr. E. E. Tyzzer has recently suggested that there are two species of coccidia in chickens. One species is thought to be non-pathogenic and not to produce hemorrhages, while the other is considered to be pathogenic and the causative organism involved in acute attacks accompanied by the voiding of bloody droppings. Observations in California support the idea that two species of coccidia exist but do not permit the conclusion that the one which does not cause hemorrhage is strictly non-pathogenic.

Attendants may carry infection into brooder houses from contaminated yards. Chicks may become infected when allowed to run in orchards or gardens that have been fertilized with chicken manure. The infection may be introduced on to new premises by such means as healthy adult fowls which harbor the germs, wild birds, dust-laden wind, visitors, etc. It is improbable that infected hens ever transmit the disease through the egg to their offspring.

Usually the first indication of the presence of coccidiosis in a flock of chicks is droopiness of a few. The affected birds remain close to the hover, do not eat, and stand with wings drooping, head drawn in, and eyes closed for long periods of time unless disturbed. This attitude is quite characteristic of the disease (fig. 20). Droopy birds may be seen for two or three days before any deaths occur.

The droppings of affected chicks frequently contain blood. The amount varies from that sufficient only to slightly tinge the droppings to enough to give them the appearance of consisting entirely of blood. The bloody droppings usually are seen in the early stages of the outbreak. Occasionally they are the first indication of disease observed. Although the presence of blood in the droppings is a frequently occurring and quite characteristic symptom, in many outbreaks of coccidiosis this does not occur. Therefore, "bloody diarrhea," the name for the disease commonly used by poultrymen, does not always apply.

The heaviest mortality usually occurs during the first week or ten days after the first droopiness appears. After this, deaths become less frequent but may continue for from three to four weeks. When effective measures of control are not adopted, a large percentage of the survivors fail to develop normally. Such birds may never become profitable and the loss to the poultrymen from this source may be as great as that resulting from mortality.

The changes in the organs observed upon examination of dead chicks are usually confined to the ceca. The walls of these organs are, as a rule, thickened. The ceca may be normal in size or markedly distended. They often contain sufficient blood to give them a reddish appearance. The ceca of chicks which linger for a week or more before death often contain an accumulation of grayish or yellowish-white, cheesy material (fig. 21). Frequently chicks which have died of coccidiosis exhibit no definite marked change in the appearance of the ceca or of the cecal contents. In such cases, the disease can be recognized only by the finding of oöcysts on microscopic examination of the contents of the ceca.



Fig. 20.—Chick with coccidiosis.



Fig. 21.—Ceca of chick with coccidiosis.

Occasionally the liver is involved. The liver lesions, when present, consist of small, white or yellowish specks on the surface.

The chronic type of the disease is seen in older birds, usually pullets between the ages of four and eight months. It develops slowly and may affect only a few fowls in a flock. The prominent symptoms are loss of appetite, roughened, dirty plumage, gradual loss of flesh, paleness of the comb and wattles, leg weakness or "paralysis" of the legs, or sluggish, weak movements when walking. In extreme cases of leg weakness, the fowl may lie on its side with both legs extended backward (fig. 22), or it may lie on its breast with one leg extended forward and the other backward (fig. 23). Some pullets that are unable to stand appear quite normal in a sitting posture.



Fig. 22.—Seven-months-old pullet with chronic coccidiosis.

Death from chronic infection occurs only after several days or even weeks of sickness. Chronic coccidiosis may be easily confused with the symptoms resulting from external parasites, intestinal worms or nutritional disturbances.

In pullets with the chronic type of the disease, the lesions are confined to the small intestines. The intestinal walls become thickened and the lining has a spongy appearance. In severe cases, red blotches or hemorrhagic areas may be present. Occasionally there is a sloughing of patches of the lining. The ceca rarely show any change.

Chronic coccidiosis can be differentiated from the effects on chickens of certain species of intestinal worms or from some nutritional disturbances only by microscopic examination of intestinal contents or of scrapings from the lining of the intestines of affected fowls.

Frequently both coccidial parasites and one or more species of intestinal worms may be present in the same fowl. Therefore, before an intelligent decision can be made as to the treatment of fowls suspected of having chronic coccidiosis, it must be determined: first, whether coccidial parasites are present; second, whether other intestinal parasites are present; and third, whether there is any relation between nutrition and the condition of the fowls.

Control.—Outbreaks of coccidiosis can usually be promptly controlled by feeding sufficient dry or liquid skim-milk or buttermilk and by maintaining proper sanitation in the brooder houses and yards. If the sanitary measures are neglected little benefit from milk feeding can be expected.



Fig. 23.—Four-months-old pullet with chronic coccidiosis.

If *dry milk* is used it should constitute 40 per cent of the mash. The composition of the mash is not of importance as long as it contains 40 per cent of dry milk and makes a suitable mixture for feeding to young chickens. A mixture that has been found satisfactory consists of the following ingredients:

Dry skim-milk or buttermilk	40 pounds
Wheat bran	10 pounds
Yellow cornmeal	30 pounds
Ground barley	20 pounds

Start feeding the mash as soon as the presence of the disease is determined. Keep the mash constantly before the chicks in hoppers or troughs constructed so as to prevent waste.

Feed grain once or twice daily but restrict the amount to from one-third to one-half the weight of mash consumed. If more grain is fed, mash consumption will be reduced and less satisfactory results will be obtained. Continue this system of mash and grain feeding as long as there is any indication of the disease. This usually requires from one to two weeks. If desired, the ration can then be very gradually changed to the one in use before coccidiosis started. Do not start the change in the ration too soon nor make it too abruptly. Feed greens as usual. If the supply of greens is insufficient, add one quart of cod-liver oil to each one hundred pounds of mash. This is also advisable when weather conditions or weakness of chicks prevents them from running outside.

Chicks that are run on contaminated soil are less liable to become fatally infected with coccidiosis if they are fed according to this method from the fourth to the eighth week. Feeding mash containing 40 per cent dry milk for a longer period is not recommended.

When *liquid milk*, such as buttermilk or skim-milk, is to be used, it should be of good quality. Keep the milk constantly before the chicks in fountains or troughs. If troughs are used, provide covers that will prevent the chicks from walking in them or roosting over them. Provide sufficient containers so that all the chicks can drink freely and the weaker chicks will not be crowded away. Allow the chicks no water. Feed no mash. Feed grain twice daily, very sparingly in the morning and a larger amount at night. Feed greens as usual. Add one quart of cod-liver oil to each one hundred pounds of mash if the supply of greens is insufficient or the chicks cannot go out of doors. After all evidence of the disease has disappeared, the feeding of mash may be very gradually resumed, water again given, and the amount of milk reduced. Do not start this change in feeding too soon nor complete it too rapidly.

A condensed milk product, such as semi-solid buttermilk, after dilution, may be used in the same manner as buttermilk. Use one part to two or three parts of water. Greater dilutions are less beneficial. Many poultrymen report satisfactory results from the use of undiluted semi-solid buttermilk. If it is fed in this way, water must be supplied.

The *sanitary measures* recommended are designed to prevent the spread of the germs from the diseased chicks and to provide conditions favorable to maintaining good health so that the natural resistance of the chicks to disease will not be lowered.

When coccidiosis appears, thoroughly clean the brooder houses or move the chicks to other brooders that have been cleaned and disin-

fected. Cover the floor with litter. Clean the houses and put in fresh litter daily. When chicks are fed liberally with milk, either dry or liquid, the droppings become watery and are voided frequently. This, in itself, is not harmful. The watery consistency of the droppings, however, causes the litter and floor to become wet in a short time. This makes it necessary to *clean out the houses and renew the litter daily* in order to keep the floor dry. The daily cleaning also removes from the houses a large percentage of the coccidial parasites present in the droppings from infected chicks. Divide the chicks into as many flocks as the number of brooders available will permit. When the flocks are small, it is easier to keep the houses clean and dry. Be sure that the brooder houses are kept warm enough and are well ventilated. Warmth and fresh air are essential for the health of the chicks and also assist in keeping the houses dry. Separate the visibly sick chicks from those apparently healthy as soon as the disease appears. Kill the worst cases. Burn the dead. Watch the healthy chicks carefully so that those that later become sick can be promptly detected and removed. Contamination of the soil with coccidiosis germs is greatest in that part of the yards adjacent to the houses where the chicks spend most of their time when outside. The surface of this part of the yard should be scraped or swept and the sweepings removed. The entire yard should be plowed as deeply as possible. Corners and other places that cannot be reached by the plow should be spaded.

In experimental trials to determine the value of hydrochloric acid, catechu, a mixture of bichloride of mercury and sulphocarbonates (coccidiosis powder), potassium dichromate, powdered ipecac, and bismuth subnitrate, for combating coccidiosis, none of these drugs were found to be effective.

BACILLARY WHITE DIARRHEA OF CHICKS

Description.—Bacillary white diarrhea is a highly contagious disease of young chicks, caused by infection with a specific germ known as *Bacterium pullorum*. The infection also occurs in adults, but is seldom recognized since it is localized in the ovaries (fig. 24) and usually produces no visible symptoms. However, the disease in adults, breeding stock in particular, presents a serious problem because some of the eggs laid by such fowls carry the infection and transmit it directly to chicks hatched from them. Infection from this source is the most common cause of the start of outbreaks among chicks. Outbreaks may also start from infection picked up by chicks that are hatched

in contaminated incubators or reared in contaminated brooders or pens. The droppings of infected chicks contain large numbers of the germs and are the means of rapidly spreading the disease through a flock.

The disease usually appears within three days after the chicks are hatched. The mortality is usually high, the average probably being more than 50 per cent. Losses are greatest during the first two weeks but may continue for three or four weeks. In the acute type of the disease the chicks become drowsy, their wings droop, they sway back and forth when in a standing position and move with an unsteady gait and many of them die within a few hours. There is often a deposit of chalk-like material on the feathers around the vent. In cases of long duration, the accumulation may reach sufficient size to block up the vent. Chicks that survive for a longer period appear weak, dull, fail to grow, and have a tendency to the development of a large abdomen. Mildly infected chicks grow to maturity and, while they appear to be healthy, harbor the infection in the ovaries and become carriers of it.

The liver of dead chicks is usually either a uniform yellowish-brown color or yellowish-brown streaked with red. Unabsorbed yolk is nearly always present in the abdominal cavity. The yolk may be nearly full size, liquid in consistency, and yellowish-brown in color or smaller in size and gelatinous or cheesy, according to the length of time the chick may have lived. Changes in the other organs are difficult to detect.

Disease in young chicks manifested by symptoms and lesions identical with those due to infection with *Bacterium pullorum* frequently results from "common" causes such as improper incubation, overheating, chilling, improper feeding and housing or any other brooding error that may lower the vitality of the chicks. *The only means of distinguishing bacillary white diarrhea from disease due to a non-infectious cause is by bacteriologic examination.* Owners of flocks in which losses suspected to be due to bacillary white diarrhea occur should submit specimens for examination to the laboratories of the Division of Veterinary Science, University of California.

Prevention and Control.—Bacillary white diarrhea is such a destructive disease that every precaution should be taken to prevent its occurrence.

The danger of chicks becoming infected from contaminated incubators and brooders can be overcome by always cleaning and disinfecting incubators before eggs are set and brooders (including

troughs, fountains and other accessories) before chicks are placed in them. Many of the chicks that hatch from infected eggs are undersized or weak. Therefore the practice of destroying all "cull" chicks as soon as they hatch would, in some instances at least, assist in preventing a serious outbreak.

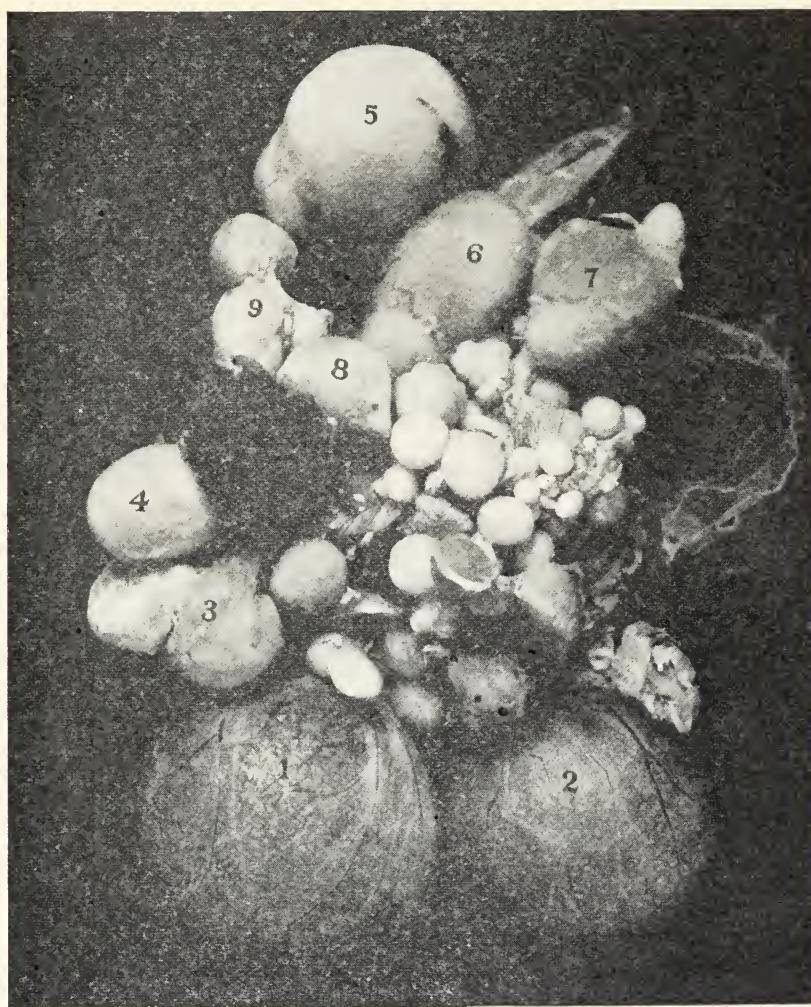
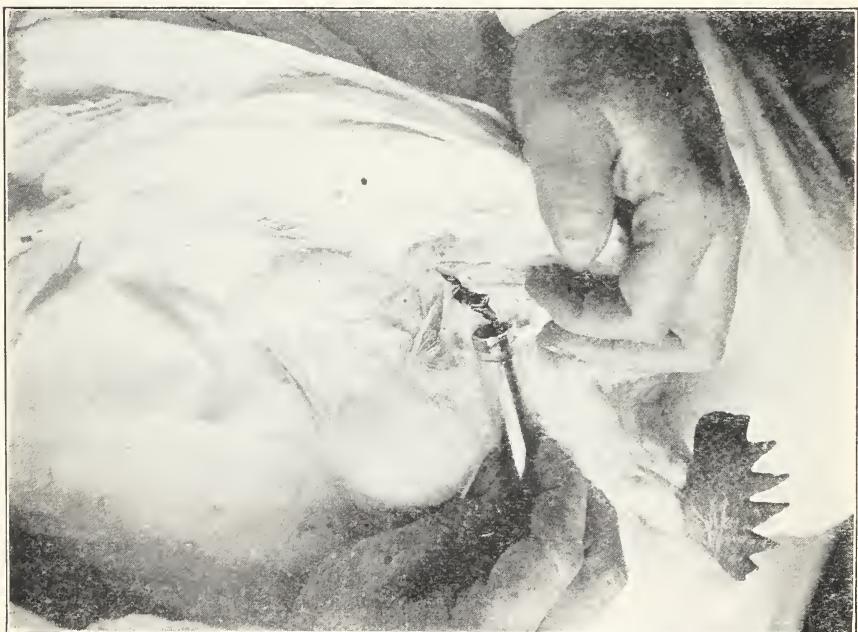


Fig. 24.—Ovaries of a hen infected with the bacillary white diarrhea germ. Numbers 1 and 2 are normal yolks. Numbers 3 to 9 and many of the smaller yolks are abnormal because of the infection.

The mature hen as a source of the infection in chicks may be avoided by securing eggs, chicks and breeding stock only from flocks that are free from infection with the bacillary white diarrhea germ.



Figs. 25 and 26.—Securing blood for agglutination test for bacillary white diarrhea infection in breeding stock.

Many infected hens can be eliminated by careful culling of flocks and using for breeding purposes only the highest producing hens. The only definite means of detecting infected hens, however, is a blood test, known as an agglutination test (figs. 25 and 26). A single test will not detect all birds in a flock that are infected, but when a flock is tested annually, or more frequently, and only birds that pass the test are used for breeding, the danger of losses from bacillary white diarrhea among offspring from the flock will be minimized. Detailed information regarding the test may be obtained from the Division of Veterinary Science, University of California, Berkeley.

There are no specific measures to be used in combating outbreaks. Sanitary precautions, such as the prompt removal and destruction of all sick and dead chicks, dividing the flock into small units, and moving the chicks into cleaned and disinfected pens, will assist in reducing the mortality. Drugs have been found to be of little benefit. Recent experiments at the Rhode Island Agricultural Experiment Station, however, indicate that replacing the drinking water with a dilute solution of a chlorine disinfectant may help to decrease mortality.

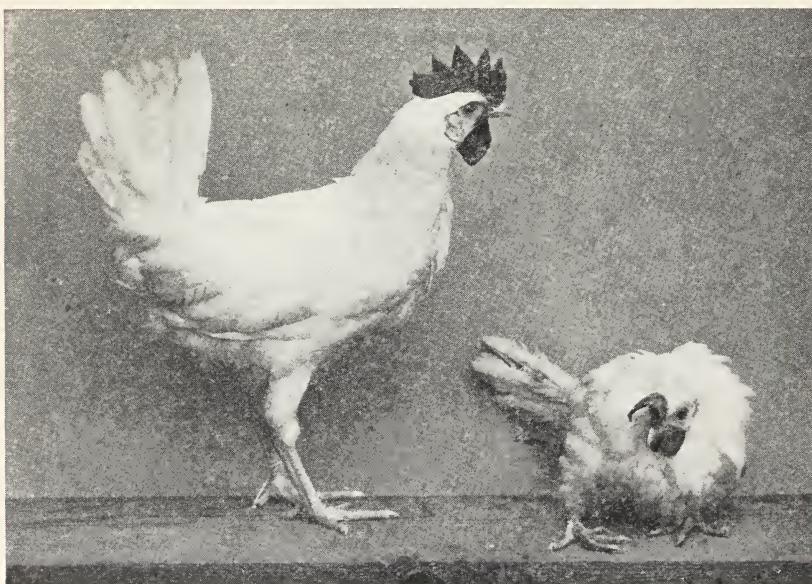


Fig. 27.—These birds were raised together in a well lighted house and fed the same ration. The one on the left was placed in a box outside in the sunshine for about an hour each day. The one on the right received sunlight only through a glass window. This is a pronounced case of leg weakness due entirely to lack of exposure to direct sunlight.

LEG WEAKNESS OF CHICKS

Leg weakness is of common occurrence among chicks and for many years was thought to be due to improper diet and confinement in houses. It is now known that the trouble results when chicks do not get sufficient exposure to direct sunlight (fig. 27). A deficiency of minerals in the ration may also cause leg weakness, but the common cause is a deficiency of direct sunlight. It has been generally known that flocks in which leg weakness occurred were benefited by being allowed to run outside. The benefit is due to exposure to the sunlight, not to the chicks getting on the ground as was commonly supposed.

Leg weakness is apt to occur whenever there is a long period of cloudy or rainy weather during the brooding season. Relief is obtained by making certain that the chicks get one or two hours of exposure to direct sunlight every day. Sunlight that passes through an ordinary glass window is of no benefit. Cod-liver oil possesses the same property of preventing and curing leg weakness as sunlight. It is usually easier to give cod-liver oil than to see that all chicks get sufficient exposure to sunlight. Feeding mash containing 1 quart of cod-liver oil to each 100 pounds to an affected flock will quickly stop the occurrence of leg weakness. Feeding such a mixture throughout the brooding season will entirely prevent the trouble.

BLACKHEAD IN TURKEYS

Description.—Blackhead has long been known to occur in California, and is undoubtedly responsible for severe losses. Observations made in some sections indicate that the disease has not been prevalent to any great extent in flocks that are run on well drained unirrigated ranges and grain fields. It is believed that blackhead as a serious disease will be found to be localized to a considerable degree in those sections where the land is low, wet or under irrigation, or on land on which chickens or turkeys are raised in confinement year after year.

There are two factors involved in the production of the disease, one the blackhead parasite, a microscopic organism which enters the tissues and produces the characteristic changes, and the other the cecum worm (see p. 60) which presumably opens up a way for the blackhead parasite to enter. It is possible that there are other factors that may take the place of the cecum worm in the production of blackhead, but none have been found. Turkeys become infected when they are run on soil contaminated with the blackhead parasites and the cecum worm eggs.



Fig. 28.—Ceca of a turkey affected with blackhead. One cecum shows a discolored diseased area near the tip and two near the middle. The other shows only one located below the middle.

The name blackhead is an unfortunate one. The head of the affected bird never turns black but in a certain proportion of the cases takes on a somewhat bluish color. This condition occurs in other diseases and is related to a disturbance of the circulation. A period of about two weeks elapses between the beginning of the disease and the time the affected bird shows symptoms. Birds, especially those but a few weeks old, may die so suddenly that no symptoms of illness have been noticed, but this is rather exceptional. The disease is most serious in birds during the first months of life. As already indicated resistance increases with age, especially after the first two or three months. In older birds, the disease is more chronic and the affected bird may be ill for some weeks before it succumbs or recovers.

The first change noticed in a bird affected with blackhead is that it is a trifle slower in its movements and does not feed so ambitiously. Later its movements are much slower and it is found at times standing with the head drawn in. As the disease progresses it stands for long intervals or almost continuously with head drawn in, eyes closed, and the tail and wings drooping. It may bury its head in the feathers of the back. There may be a diarrhea. The droppings are stained a sulfur color. Affected birds sometimes prefer sitting on the ground to standing.

There is nothing sufficiently characteristic about the symptoms to make it possible to distinguish blackhead from certain other diseases. A definite diagnosis can be made only by an examination of the organs of birds at autopsy.

The main changes in the organs in blackhead are confined to the ceca, or blind pouches of the intestines, and the liver. The disease of blackhead originates in the ceca, one or both being affected (fig. 28). The blackhead parasite gains entrance to the inner lining (mucosa), where it multiplies very rapidly. It extends its invasion well into the depths of the wall of the cecum, causing it to become thickened. The thickening may be general or localized to one or more areas. As a result of injury to the tissues and a weakening of the blood vessels, blood and fluids may escape into the cavity of the cecum and there, becoming more or less mixed with the contents, undergo solidification into a cheesy core. A core, however, is not always present. Enlargement of the cecum, a thickened wall and the possible presence of a yellowish cheesy core are the gross changes to be noted in this organ.

From the cecum the organism is carried by the blood stream to the liver, where it sets up a serious disturbance. The liver is much enlarged and permeated with dark red, grayish or yellowish spots

where the blackhead parasite has lodged and multiplied (fig. 29). At times instead of the changes occurring as spots, they give a cloudy appearance to considerable areas of the liver.

Prevention and Control.—Blackhead can be prevented by rearing young turkeys away from old ones and all other domestic birds and on soil free from the eggs of the cecum worm. Soil not previously



Fig. 29.—Liver of turkey affected with blackhead.

used for domestic birds, and that which has been ploughed and been under cultivation for a year during which time all domestic birds have been excluded may be regarded as safe. Wide areas, such as ranges and grain fields, may likewise be regarded as safe because, under such conditions, soil contamination does not tend to become great.

It is preferable to hatch in incubators and rear in brooders on clean ground. When hens are used for these purposes hatching and brooding should be done in different locations and clean ground for brooding should be provided each season. It is wise to plan a year in advance for brooding ground. As soon as practicable the hens with their broods should be given their freedom on clean ground. The best chance for success is where large areas are available, for there soil contamination is least likely to become serious. However, a failure to apply the principles underlying control may result in practices neutralizing the natural advantages of ranges and fields and bring about serious and unnecessary losses. Soil tends to become dangerous in places where turkeys congregate repeatedly. In the case of large bands, the flock should be kept on the move and feeding and roosting places changed frequently to keep the flock on soil as little contaminated as possible. When clean ground is not used, treatment of the flock to prevent infestation with cecum worms may assist in preventing blackhead. While there is no treatment that can be relied upon to keep the birds free from cecum worms, the continuous feeding of dry mash to which 2 per cent of tobacco dust is added may be of considerable value.

A great number of drugs and substances have been recommended by investigators and laymen for the prevention and cure of blackhead. None of these has been proved to be of value. As in the case of most other infectious diseases of animals, prevention based on sanitation is more reliable than curative measures. The best that can be done for diseased birds is to isolate them, give them good care, and feed properly—providing sour milk if possible. The results may be far from satisfying but they will be quite as much so as with any medicinal treatment and there will be no expense for drugs. To try, one after another, various drugs and substances recommended to the turkey raiser is productive of much harm. Some of the substances used are poisonous or irritating to the intestinal tract and other organs. The drinking water is frequently rendered distasteful by the addition of medicines which prevents the birds from taking a proper amount of water.

After the sick birds have been taken out, the flock should be moved to clean ground and carefully watched so that new cases can be promptly detected and removed. Treating the flock for cecum worms may also assist in preventing further spread of the disease through the flock.

COMMON DISEASES OF BIRDS

Most "common" or non-infectious diseases of birds are of an intestinal origin, that is, due primarily to indigestion. Therefore, many birds that become droopy and which would die if left alone may



Fif. 30.—A safe method of administering castor oil or other liquid medicine to a fowl.

recover if treated properly. All droopy birds should be removed from a flock and given one-half or one ounce of castor oil. Castor oil or other liquids can be safely given through a rubber tube attached to

the nozzle of a hard-rubber veterinary dose syringe of a suitable capacity and passed down the throat into the crop (fig. 30). If the practice of giving castor oil to all droopy birds is followed, the mortality can be greatly decreased. Furthermore the practice of always removing sick birds from the flock, no matter what the cause of the sickness, will be a great assistance in preventing any infectious disease from gaining a foothold in the flock.

When intestinal disturbance becomes prevalent in a flock give epsom salts to the whole flock by dissolving 1 pound for each 100 to 125 adult birds in as much water as will be consumed in three or four hours. For younger birds decrease the amount of the salts according to the age of the birds. Such trouble is usually the result of incorrect methods of feeding. Advice regarding proper rations for poultry should be obtained and any errors found in the feeding practices in use should be corrected.

LICE

These insects can be distinguished from all other parasites on the body by the fact that they have three pairs of legs and their bodies, divided into three sections, the head, thorax, and abdomen, are flattened dorso-ventrally, i.e., as if a flattening force had been applied on their backs. They are seldom over $\frac{3}{16}$ of an inch in length and of a yellow or grayish color, sometimes ornamented with dark stripes but never uniformly dark brown or red. Parasites of these latter colors may be fleas, mites, or ticks.

The entire life of lice, including the egg stage, is spent on the body of the birds. It is only by accident that the parasites leave their hosts except to migrate to other hosts of the same species. The eggs require about a week to hatch, after which maturity is reached in about two weeks.

None of the present-day remedies are harmful to the egg stage. This necessitates the use of a substance that will remain on the body long enough to kill the emerging young, or a repetition of the treatment between 8 and 14 days after the first treatment.

Sodium fluoride is the only remedy that answers the first requirement of eliminating all the lice with a single treatment. It also has the advantages (1) of being safe to both birds and operator, (2) of accomplishing a complete elimination of the lice, and (3) of being suitable for baby chicks and setting hens. No other treatment combines these advantages, for which reason we restrict our recommendations to this single type of remedy.

Sodium fluoride may be obtained from drug stores as a white powder (commercial form) or as crystals (chemically pure). It may be applied in three ways, viz., by the "pinch method," dusting, and dipping.

The "pinch method" consists of placing on the skin of each fowl approximately ten "pinches" (amount held between thumb and fore finger) of the commercial sodium fluoride, distributed on the breast, each thigh, below the vent, on each side of the back, on the neck, on the head, and finally one sprinkled on the underside of each outspread wing. The birds, when treated, should be held over a shallow pan or newspaper in order that the excess of the chemical may be saved.

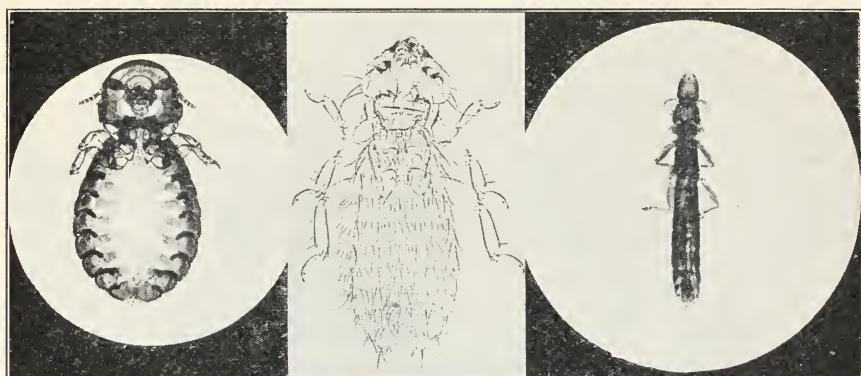


Fig. 31.—Three common species of poultry lice.

The powdered sodium fluoride is sometimes mixed with three or four times its bulk of flour or talc and applied with a large shaker, ruffling the feathers of the bird as the chemical is applied. This procedure is not as economical of material or as efficient as the pinch method and the excess of chemical in the air is irritating to birds and operators.

Dipping in sodium-fluoride solution is rapidly becoming a standard method of treatment among a large group of producers that have overcome the poultrymen's prejudice against wetting their birds. In California, birds may be dipped safely in almost every month of the year by choosing a warm day with little wind and completing the operations an hour or two before sundown in order that the fowls may dry thoroughly before roosting for the night. The solution should be prepared in a wooden container, avoiding contact with galvanized iron. The ordinary wooden wash tub is excellent for this purpose. One ounce of the commercial sodium fluoride, or two-thirds of an ounce of the chemically pure crystals, should be dissolved in

each gallon of tepid water. The best method for dipping the birds is to hold them with the left hand by both wings. They are then placed feet foremost in the warm dip and submerged until only the head remains above the surface. They should be held in this position from 20 to 25 seconds while the feathers are ruffled to permit penetration of the liquid. Just before removal, the head should be ducked under the surface. The birds should be held above the dip for two or three seconds to allow them to drip before releasing them. One hundred birds will use up approximately five gallons of dip, on which basis material should be available at the start of operations to keep the dip replenished.

The dipping method kills all lice immediately but where it is applied as a powder three or four days will pass before elimination is complete. If the birds are caught and handed to the operator, from 100 to 125 birds an hour can be treated by dipping or dusting, and approximately 60 to 75 an hour by the "pinch" method.

Prevention is accomplished to some extent by supplying the birds with ample dusting boxes filled with fine road dust to which sodium fluosilicate has been added at the rate of one part of the chemical to three parts of dust. The best advice, however, is to treat all new acquisitions to the flock before permitting them to mix with the clean birds. Brooding hens, unless definitely known to be free from lice, should be treated before being placed with newly hatched chicks. Spraying the house and roosts has little effect on the lice problem.

MITES

Two distinct groups of mites attack poultry. One group is migratory, passing the greater portion of its life, not on the birds, but in cracks and crevices about the poultry houses from which they make nightly raids upon the roosting poultry to suck blood. The other group passes its entire life history on the birds by burrowing beneath the scales of the legs, into the skin at the base of the feathers, into the shaft of the feathers themselves, or even penetrating the internal air sacs.

The scaly leg mite (*Cnemidocoptes mutans*) gets its name from its habit of burrowing beneath the scales of the leg, where its presence and activities cause a lifting of the scales and a swollen condition of the shank which, in advanced cases, amounts to so pronounced a distortion and deformity that the affected birds are unable to walk. The mites themselves are microscopic and the poultryman generally makes a diagnosis of the trouble by observing the symptoms noted above. The trouble is pronounced in older birds.

Treatment consists of dipping the legs of the birds in a mixture of equal parts of crude oil and raw linseed oil, taking precautions to avoid wetting the legs above the scaly portion. This treatment should be repeated in about three weeks unless marked improvement is noted. This is, however, seldom necessary.

The legs of newly acquired birds should be observed carefully in order that infected birds may be segregated and treated before being placed with the clean flock.

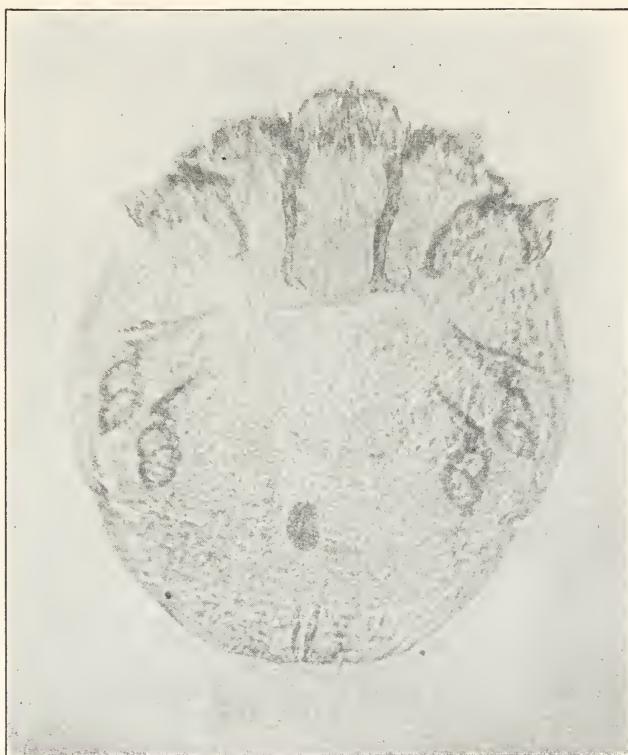


Fig. 32.—Photomicrograph of the scaly leg mite.

The depluming mite (*Cnemidocoptes laevis*) is a microscopic parasite which burrows into the skin at the base of the feathers, producing an intense itching which causes the birds to pluck out the feathers, leaving nude areas at the more severely infested places. No general treatment is available, but individual birds may be cured by the thorough application at intervals of about five days, of a sulfur ointment made by mixing three parts of flowers of sulfur with one part of lard.

The common chicken mite (*Dermanyssus gallinae*) is a small grayish red mite, approximately the size of a pinhead when filled with blood. It may be distinguished from the insect parasites by its four pairs of legs, in place of the insects' three, and by the fact that its body is not divided into separate subdivisions. Its food is blood which it draws from the birds by means of long piercing stylet-like mouth-parts. Unlike the other mites mentioned above, it hides away during the day in cracks and crevices about the hen house, migrating to the roosting birds at night to suck blood. The experienced poultryman is warned of their presence by the "salt and pepper" marks on the roosts, tiny circular black and white dots slightly smaller than "fly specks" caused by the excrement of the mites. However, if present, even a cursory examination of a few cracks or crevices in the vicinity of the roosts will reveal myriads of these mites.

Inasmuch as the mites are seldom found on the bodies of the birds during the day, except in the first feeding period when they sometimes remain attached for a night and a day, or in dark nest boxes, control measures are directed most advantageously against the hiding places. A thorough clean-up of the premises to which the birds have access, together with the elimination of every useless article therein, such as boxes, coops, boards, etc., is the first step. Old nesting material should be burned and if the infestation is severe, roosts and nests should be dismantled to be replaced by construction that will facilitate future clean-ups. Methods must now be directed against the cracks and crevices of the floors, walls, and even the roof of the poultry house. In heavy infestations the mites sometimes migrate to the outside of the house when the inside is sprayed. They should be looked for along the cracks on the outside and, if present there, a spraying of the outside will be decidedly worth while. The most efficient manner of accomplishing this end is by the use of liquid insecticides applied preferably by "bucket" or "knapsack" spray pumps. A coarse spray is most effective and should be applied to each area from several different angles to insure penetration into all hiding places. Many of the existing sprays are efficient. Any of the dips used on domesticated animals made up in a slightly stronger solution than directed for the dipping of domesticated animals will give fairly satisfactory results. The most satisfactory of all applications, however, are the wood preservers similar to "Carbolineum" that have the coal-tar product anthracene oil as a base. These have the advantage of being effective over a long period and of soaking into the wood rapidly without leaving a greasy residue to soil the feet, feathers and eggs of the birds. They should be diluted about one-half with kerosene to

facilitate spraying. One careful, thorough treatment generally proves sufficient with this type of spray.

Crude oil diluted sufficiently with kerosene to make it easily sprayed is efficient in killing the mites and is sufficiently durable but leaves the roosts, floors, etc., in an oily condition so that the flock must be excluded from the treated premises for some time in order to avoid soiling of feathers and eggs.

Whitewash containing 3 to 5 per cent of crude carbolic acid kills large numbers of mites but is not nearly as effective as anthracene oil or crude oil.

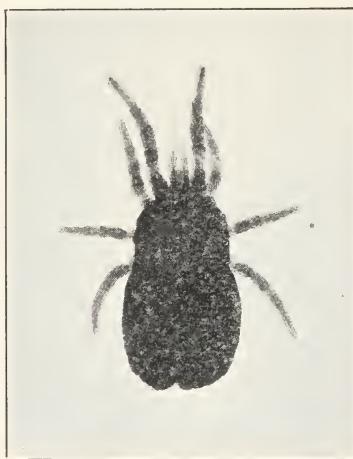


Fig. 33.—The common poultry mite greatly enlarged.

The common chicken mite is introduced into clean flocks in many cases in contaminated shipping coops. In some cases the introduction may be accomplished by a few young mites that are engorging for the first time on the introduced fowls. To overcome this possibility, newly acquired birds should be kept in special coops for two or three days before being placed in clean houses. These coops should then be destroyed or disinfected with boiling water or with one of the sprays suggested above. Shipping coops from other poultry plants should not be left in or near clean houses, nor should second-hand equipment be introduced unless the proper precautions of disinfection are taken. Mites will live for from three to five months without food, a fact which should be considered when vacant buildings are to be occupied by clean flocks. In cases where the control of the mite is impossible owing to the character of the quarters or lack of them, some relief is afforded by wrapping the ends and other points of contact of the

roosts which have been painted thoroughly with crude oil, with rags soaked in the same substance to prevent the mites from gaining access to the fowls after they have roosted. To make this procedure effective crowding should be discouraged and the back roosts should not be near enough to the wall to permit the movement of the mites to the plumage of the birds.

The air sac mite (*Cytodites nudus*) is seldom of economic importance but constitutes a source of wonder to poultrymen on account of its habitat in the air passages of the birds, particularly in the air sacs where they can be seen as small yellow spots of very minute size. No extreme cases have ever been noted by the writers but some authors have attributed clinical symptoms similar to tuberculosis or "going light" to heavy infestations.

The quill mite (*Picobia bipectinatus*) has been taken in California. It lives in the shafts of the primary wing feathers. It is apparently of no economic importance.

TICKS

These parasites are closely related to the mites but are always larger, easily visible to the naked eye and have a thick leathery cuticula or skin. The only tick attacking fowls that is of economic importance is the so-called fowl tick or "blue bug" (*Argus persicus*). The adult tick is flat, egg-shaped in outline, dark brown in color, from $\frac{1}{4}$ to $\frac{7}{16}$ of an inch in length and about half as wide at its widest part. Its habits are essentially like those of the common chicken mite referred to above. The ticks have a remarkable ability to live for long periods without food, the specimen photographed in figure 34 having lived in a tightly corked vial in the author's desk for a period of 16 months without food. Records are available of adult ticks that have fasted for $2\frac{1}{2}$ years.

The procedure is the same as in the case of the common chicken mite, with the exception that the spray material should be stronger in every case when the dilution is made with water. The wood preservers of anthracene oil stand out as the most promising materials but treatment with these often has to be repeated at the end of three or four weeks to insure entire control. If sheep dip or other stock dips are used their dilution should be at least as strong as four parts of water to one of dip. When individual fowls are heavily infested with larvae taking their first meal, when they remain attached for several days, it is advisable to dip them in a 2 per cent coal-tar dip in case the birds show signs of weakness. The best practice, however, is to merely segregate the infested birds for a few days in an isolated

coop until the ticks become engorged and drop off when the birds may be returned to the flock and the coop destroyed or disinfected with boiling water or some of the sprays mentioned above.

The procedure here is also much the same as in the case of the common mite mentioned before. The period of quarantine mentioned for the previous mite must, however, be lengthened to five or six days in the case of the poultry tick, but may be eliminated entirely from the standpoint of tick prevention by a careful examination of the

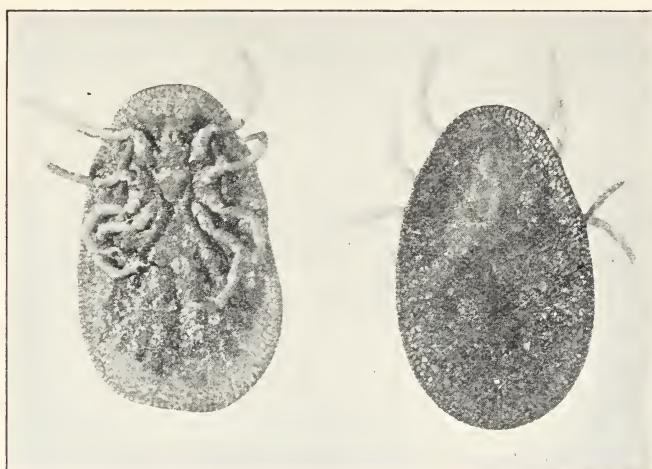


Fig. 34.—Ventral and dorsal view of the poultry tick or blue bug enlarged.

thighs, breast and sides for the round bluish-red larval ticks that can be easily seen on account of the contrasting color of their bodies and the skin of the birds.

FLEAS

These insects may be distinguished by their dark brown color, three pairs of legs, and their laterally flattened condition.

The sticktight flea (*Echidnophaga gallinaceae*), although parasitic on dogs and cats, finds its best host in poultry. This flea remains attached to the host throughout its adult life. In poultry they are generally located about the eyes and comb. The eggs laid by these attached females fall to the ground and hatch, or in case the eggs are retained in the burrows or ulcers caused by the attached females, the larvae upon hatching fall to the ground. These larvae are tiny white, caterpillar-like organisms with chewing mouthparts. They subsist on the debris or manure on the floors of houses and yards. When they have become full-grown as larvae they spin a white cocoon in which

they change from the larval stage to that of an adult, after which they attach themselves to the skin of their hosts to suck blood. The constant irritation, particularly in spots where they are present in large numbers, together with a slight burrowing activity on the part of the fleas, causes the formation of ulcers so extensive at times that blindness and subsequent death is produced.

The first step in control is to prevent further infestation. This can be accomplished by a rigid clean-up of the floors of the houses and the pens, followed by a thorough spraying with kerosene, crude oil or kerosene emulsion. Nest boxes and dropping boards should receive similar treatment. Flooding the yards with irrigation water is said to produce beneficial results. Infested birds may be relieved by dipping in a 2 per cent Creolin solution.

The dog flea (*Ctenocephalus canis*), the human flea (*Pulex irritans*), and the rat flea (*Ceratophyllus fasciatus*) are frequent inhabitants of poultry houses. These fleas attach themselves to their hosts only momentarily at the time that they suck blood, remaining unattached on the host's body or leaving it entirely between meals. The habits are otherwise like those of the "stick tight" mentioned above. The control is also similar. One precaution that applies equally well to the sticktight flea is to "turn under" all manure and other scrapings from the poultry houses and yards that is to be used for fertilizing purposes. The mere storing of the manure outside the house in piles or spreading it on the fields will not prevent the development of the flea larvae; and although it will prevent them from gaining access to confined fowls, the cats, dogs and men of the neighborhood will be the alternative recipients of their attentions unless the manure is carefully turned under by plowing or spading. The bottoms of nest boxes should be frequently and liberally sprinkled with tobacco dust or pyrethrum powder.

FLIES

The common house fly (*Musca domestica*) lays its eggs on freshly deposited manure. These hatch in about two days into tiny glistening white, footless maggots that grow rapidly for approximately a week until about a half inch in length, when they migrate from the moister part of the manure to a drier portion; here they turn into brown, barrel-shaped "pupae," from which they emerge as full grown flies in about four days.

The blow flies, flesh flies, buzz flies or meat flies, as they are variously called, will also breed in chicken manure, but prefer the bodies of dead birds left exposed on the ground or buried in shallow holes.

When garbage is fed, unless extra precautions are taken, fly breeding will occur in the garbage itself and even in moist soil that has become saturated with nitrogenous material.

Removal of the manure from the poultry houses and yards at intervals of less than seven days is the first essential. Its disposal may be accomplished in several ways. In truck and fruit regions it has a very definite cash value if protected from the rain and if the "droppings"—scrapings from the dropping board, and the "sweepings"—material from floors and yards, are segregated in fly-tight bins and collected at frequent intervals. Many producers accomplish the same result by spreading the manure daily on plots to be fertilized in a thin layer that will rapidly dry out. The fly larvae will be destroyed by the drying but it should be plowed under about once a week to avoid the emergence of fleas.

The maggot trap is another very effective method of fly control where poultry manure is concerned. This consists of a concrete pan about 9' \times 12' \times 6" deep with walls 4" thick. This is kept filled with water to which a film of oil is added. A table with legs a foot and a half high and slightly smaller in area than that of the pan is placed in the pan. The top of the table is made of inch square pieces spaced their own width apart, leaving a latticed appearance, and covered with straw to prevent the manure from falling through. The manure is then placed on this table or rack and moistened enough to make it thoroughly wet but not dripping. Each addition is treated in the same way, the whole deposit being kept wet at all times. The fly larvae flourish under this treatment but when ready to pupate their search for a dry place ends invariably in a fall to the oil-filmed water in the pan below. If the mass of manure is kept wet, this method will return a hundred per cent efficiency.

Dead fowls should be disposed of through the garbage collection system in cities or towns, but in the rural districts, incineration is just as effective. If it is necessary to bury dead animals, a hole at least a foot and a half deep should be prepared, the body covered with crude oil and the ground above well tamped.

TAPEWORMS

The effect of an infestation of tapeworms in poultry is so insidious that the cause is often either not suspected or entirely overlooked. These worms, inhabitants of the intestines, when full grown, range from almost microscopic size to ten inches, depending on the species. They have a "head" or scolex by which they attach themselves to the

walls of the intestine. Behind this is a series of segments which have their origin just behind the scolex at the "neck." As these segments grow older and new ones are formed at the "head" end, they move away from this end and finally, when mature, i.e., when full of "eggs," slough off and pass from the body of the host with its feces. If these "eggs" are eaten by some other animal which acts as an intermediary host, the young tapeworm develops up to a certain stage in its body, where it remains dormant until the host is eaten by poultry, when the larval tapeworm again becomes active, further development takes place and the worm becomes mature, sloughing off more segments of mature "eggs."

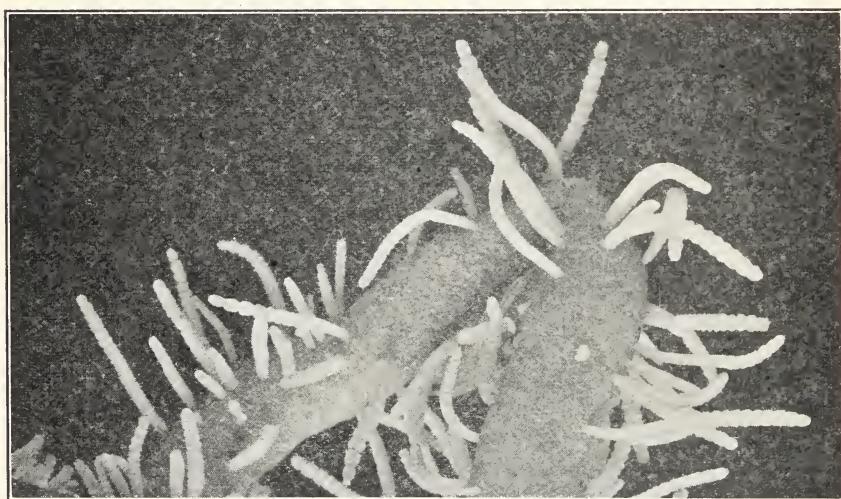


Fig. 35.—Inside of a hen's intestine, showing attached tape worms, 2 X. (At post mortem examination, the worms appear much longer and more transparent, but contract and become whiter at death.)

The common poultry tapeworm (*Choanotaenia infundibuliformis*) is, as its name implies, our commonest tapeworm. Investigations at the Oklahoma Experiment Station have demonstrated apparently that the larvae of houseflies feeding in poultry manure become the intermediary hosts. Chickens become infested by eating these larvae or the adult flies that they become.

One of the most serious tapeworms of poultry, the spiny suckered tapeworm (*Davainea echinobothrida*), has recently been taken in California. When infestations with this parasite occur, nodules varying from pin points to the size of a pea appear on the outside of the intestines causing a condition known as nodular taeniasis. This can

be differentiated from tuberculosis by the presence of the tapeworms in the lumen of the intestine and the fact that the nodules are often "bunched," several separate nodules coalescing to form one warty nodule. The larval host of this tapeworm is supposed to be a snail.

Several other tapeworms, for which stable flies, dung beetles, and slugs have been implicated as larval hosts, are reported from the United States.

Where the flocks are confined to yards and houses from which the manure with its infected fly larvae is removed promptly, and efficiently disposed of, and where other intermediary carriers are not so apt to occur, little trouble results from tapeworms.

Dr. Maurice Hall, of the United States Department of Agriculture, has recently shown that the administration of one gram of kamala to a bird, either as a pill or in a triple naught (000) capsule, is an exceedingly efficient treatment. Two grams are recommended for turkeys. No preliminary fasting is required.

ROUNDWORMS

The name "roundworm" is commonly applied to the slender wire-like worms (*Ascaridia lineata*) from $1\frac{1}{2}$ to 3 inches long that are commonly found in the intestines. Affected pullets are stunted in growth and their plumage is bedraggled and soiled. Older hens, although seldom seriously affected, have a generally unkempt appearance and their egg production is below normal. The mature worms in the intestine deposit eggs which pass out of the body of the birds in the droppings. After a few days' exposure to the air a young worm develops in the egg which, if eaten by the bird, promptly hatches and soon becomes a mature worm in the bird's intestine. These eggs are very resistant and will persist in the ground in a healthy condition for months and even years.

The average poultryman does not need to be convinced that the intestinal roundworm is a serious pest of his flock. Since 1916, the California Agricultural Experiment Station has been interested in the treatment of poultry for this parasite. Tobacco infusions made by steeping chopped tobacco stems in water were first recommended but proved too toxic for the safety of the birds and continued egg production. Dry tobacco dust was then tried out at the rate of 2 per cent by weight of the dry mash and fed over a period of 3-4 weeks. This was a distinct advance over the old infusion method but the unreliability of the nicotine content and the fact that many birds

(some which needed it most) refused to eat the treated mash, discouraged the use of this material and convinced us that an individual treatment was the proper solution of the problem.

Nicotine is the most effective vermifuge discovered thus far but inasmuch as it is a very strong poison its use in strengths sufficient to eliminate the worms was fraught with danger to the treated birds until a safer manner of administration was devised which would not decrease egg production.

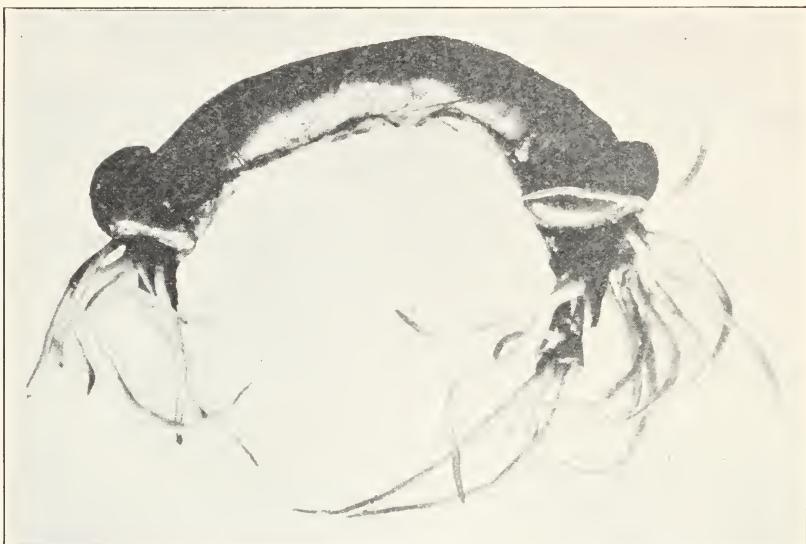


Fig. 36.—Section of intestine showing roundworms protruding from the cut ends.

In 1923 the California Agricultural Experiment Station reported concerning the mixture of nicotine sulfate (Black Leaf 40) with a special fuller's earth known as Lloyd's Alkaloidal Reagent. For some as yet unknown reason this particular clay has the power of protecting the treated bird from the toxic action of the nicotine and yet liberating the alkaloid (nicotine) in sufficient quantities to eliminate the worms. Most other clays lack this property and capsules using substitutes are decidedly toxic.

The formula which has proved most satisfactory is made by mixing 6.6 cubic centimeters (7.92 grams) of Black Leaf 40 with 16 grams of Lloyd's Alkaloidal Reagent. After a thorough mixing the powder is then packed in No. 2 gelatine capsules in sufficient quantities to weigh, when filled, from 350-400 milligrams.

The dosage is one capsule to a bird. Care *must* be taken to place the capsule well down the bird's throat and then with the thumb and forefinger the capsule should be located from the outside and slid down to the crop. Badly emaciated birds are sometimes poisoned by this dosage but any fairly normal bird over eight weeks of age will not be affected by the treatment. For badly emaciated birds and birds under eight weeks of age from $\frac{1}{2}$ to $\frac{1}{4}$ of the powder should be squeezed out of the capsule before administration. It is not necessary or even advisable to starve the birds before treatment. For turkeys some growers have reported good results from the administration of the same dosage recommended for hens, while others feel that two capsules per bird are necessary.



Fig. 37.—Highly magnified eggs of cecum worm (left) and intestinal round worm (right), which pass out in the droppings and contaminate the yards.

These capsules are now prepared by a number of commercial houses or may be mixed by your local druggist on prescription. The success of the treatment has caused many unscrupulous concerns to attempt to market a substitute capsule. If the label bears a registry number from the California State Department of Agriculture, however, you may be assured that the capsules are satisfactory, as that office has taken steps to test the toxicity as well as the nicotine content before a license is issued.

With this type of treatment the worms are eliminated in approximately forty-eight hours, after which the poultryman should clean up the dropping boards and pens to prevent reinestation from worm

eggs already prevalent on the premises. Chemical sprays are useless for this purpose. Reliance should be placed on a thorough, mechanical cleaning of the houses; plowing is quite efficient for the yards. The greatest single step that can be accomplished in sanitation is to eliminate "wet spots" in the yards. Marked results have followed the installation of gravel pits covered with narrow cleats under all drinking fountains. This prevents access by the birds to the usual wet soil surrounding the average drinking trough. Moist soil serves as an incubator for the worm eggs deposited in the droppings of infested birds.

CECUM WORMS

These tiny parasites, measuring from $\frac{1}{2}$ to $\frac{3}{4}$ of an inch in length, are found in the ceca or "blind guts" of the intestine. On account of their small size they are often overlooked by the poultryman or taken for the young of intestinal round worms and their harmful effects are minimized or ignored. Their presence on the walls of these organs interrupts their normal functioning and in the case of baby chicks, may result in death as early as the tenth day. On account of their sheltered position, they are very hard to remove. Large doses of tobacco dust have been known to cause their removal but no definite data on this point are available at the present time. Infection occurs in the same manner as outlined for the round worms and preventive measures should be taken with chicks and pullets along the same lines.

GIZZARD WORMS

Gizzard worms (*Cheilospirura lamulosa*) are small worms frequently found coiled under the outer covering of the gizzard. We have never seen any birds seriously affected by their presence but these instances have been reported. Although it is claimed that turpentine is beneficial, a single trial in one laboratory failed to show any results. It is suspected that the common gray sow bug so numerous in moist, dark places is a carrier of this parasite.

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